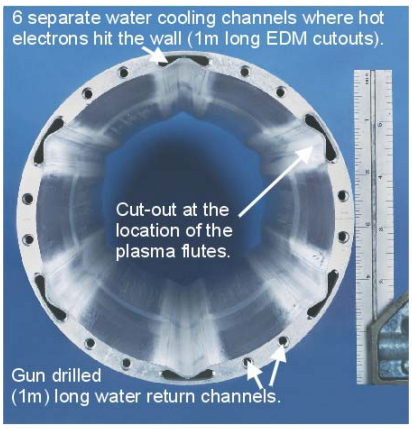
The VENUS Project: World-Record High Magnetic Confinement Fields and First Analyzed Ion Beam!

The four-year VENUS (Versatile ECR ion source for NUclear Science) project has recently achieved two major milestones: The first plasma was ignited in June 2002, following by the first analyzed ion beam of high charge state ions in September.

VENUS is a next generation superconducting ECR ion source, designed to produce high current high charge state ions for the 88-Inch Cyclotron. VENUS also serves as the prototype ion source for the RIA (Rare Isotope Accelerator) front end. The magnetic confinement configuration consists of three superconducting axial coils and six superconducting radial coils in a sextupole configuration. The nominal design fields of the axial magnets are 4T at injection and 3T at extraction; the nominal radial design field strength at the plasma chamber wall is 2T, making VENUS the world most powerful ECR plasma confinement structure.The strong forces between the sextupole and the solenoid coils made the design of the superconducting magnets a challenging undertaking. The first major milestone was achieved, when the design field values were exceeded during the magnet tests in September 2000. Clyde Taylor from the Supercon group of the Accelerator & Fusion Research Division was responsible for the superconducting magnet design.



The VENUS mechanical design has been optimized for maximum ion source performance as well as easy serviceability for operational use. Several innovative mechanical design solutions were incorporated to accommodate the physics and engineering requirements. One of the most challenging parts was the 1 m long plasma chamber. It is made out of aluminum with 18 gun-drilled water-cooling channels. Six of the channels were further opened up with an EDM wire cut at the magnetic poles of the sextupole. The drilling and EDM cuts were done in outside shops, the final welding was done at LBNL.

The control system of VENUS is completely PLC based. A user-friendly graphical interface has been programmed to quickly diagnose the system, watch the interlocks and tune the ion source. Roger Dwinell is the electrical lead engineer of the project. He is assisted by Pat Casey (electrical engineer and coordinator), Dennis Collins (microwave systems), Jim Rice, Daniel Girlington, Gudrun Kleist, and George Potter.

The project's lead mechanical engineer is Steve Abbott. The lead technician responsible for the source installation was (now retired) Byron Nofrey. Since VENUS incorporated several challenging engineering solutions the project relied on many technical experts from LBNL: Brian Bentley, Bob Connors, Bob Conroy, Al Harcourt, John Haugrud, Don Lester, Ron Oort, Bob Shannon, Jeff Trigg, Dan Williams, Tim Williams. Bob MacGill and (retired) Charlie Matuk were responsible for the design of major VENUS subcomponents.
The VENUS project manager and project scientist was Matthaeus Leitner, who is now working on a new accelerator project for the Heavy Ion Fusion group in LBNL.